PROGRAM GUIDE DATA DISTRIBUTION
SYSTEM WITH CONFIGURABLE QUEUES

Background of the Invention

This invention relates to data transmission,
5   and more particularly, to program guide data
distribution for interactive television program guides.

Cable, satellite, and broadcast television
systems provide viewers with a large number of
television channels. Viewers have traditionally
10 consulted printed television program schedules to
determine the programs being broadcast at a particular
time. More recently, interactive electronic television
program guides have been developed that allow
television program information to be displayed on a
15 viewer's television.

Interactive program guides are typically
implemented on set-top boxes. Such program guides
allow users to view television program listings in
different display formats. For example, a user may
20 instruct the program guide to display a grid of program
listings organized in a channel-ordered or a time-
ordered list. Users may also search and sort program
listing by theme (e.g., movies, sports, etc.) or by
title (i.e, alphabetically). A user may view

additional information on a program by placing a highlight region on a desired program listing and pressing an "info" button. The user may purchase a pay program from the program guide by placing the highlight

5 region on a program listing and pressing an "OK" button. Some systems allow the user to select a program for recording by placing the highlight region on a program listing and pressing a "record" button.

Program guide data such as program listings,

10 pay-per-view program purchasing information, promotional information, etc. is provided to users' set-top boxes with a data distribution system. Program guide data is typically stored in a central program guide database. Periodically, selected program guide

15 data from the central database is transmitted to the headend facilities of various cable systems. Each headend distributes the program guide data to the set-top boxes in its system.

It is sometimes difficult to distribute

20 program guide data efficiently. Some program guide data (e.g., for current listings) has a higher priority than other program guide data (e.g., for future listings). Moreover, the set-top boxes to which the data must be provided are typically spread over a large

25 geographic area and different groups of set-top boxes require different sets of program guide data. As a result, the program guide data needed for one area is often different than the program guide data needed for another area. It would be desirable if the data

30 processing tasks for different areas could be handled separately to improve system throughput. Moreover, when new cable systems are added, the bandwidth of the

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data transmission system may start to become filled. It would be desirable if the program guide data provider were able to reconfigure the data transmission system to accommodate such new systems within the
5 available bandwidth of the data transmission system. Another feature that would be useful for a program guide data distribution system is the ability to ease the processing requirements imposed on the cable systems when distributing the program guide data to the
10 set-top boxes.

It is therefore an object of the present invention to provide an improved arrangement for distributing television program guide data from a centralized program guide database to the set-top boxes
15 or other television equipment on which users have implemented television program guides.

Summary of the Invention

This and other objects of the invention are accomplished in accordance with the principles of the
20 present invention by providing a system in which program guide data is distributed from a main facility to receivers such as set-top boxes through local systems. The local systems may be cable systems, satellite systems, or broadcast television systems.
25 A program guide database in the main facility is used to store a comprehensive set of program guide data. A platform-specific processor implemented on the main facility may be used to extract selected portions of the program guide data. Platform-specific data may
30 be added to the extracted portions of program guide data by the platform-specific processor.

The platform-specific processor passes the program guide data to which the platform-specific data has been added to a queue generator. The queue generator may be implemented on the main facility. The

5   operator of the main facility provides the queue generator with queue configuration data. The queue generator forms multiple master queues for the program guide data based on the queue configuration data supplied by the operator. The operator may supply the

10 queue configuration data using any convenient input interface (e.g., a mouse, a keyboard, a diskette containing predefined queue configuration data, etc.). The operator can reconfigure the data transmission system whenever a new local system is added to

15 accommodate such new local systems within the existing bandwidth of the data transmission system.

The master queues contain ordered lists, each of which contains references to data records containing the program guide data. The queue generator preferably

20 attaches version number information to the data records.

The queue generator generally provides the program guide data for the master queues to multiple feed generators, which may be implemented, for example,

25 on an uplink facility or in the main facility. Each feed generator has an associated list of receiver addresses to which it may distribute data. Preferably, each feed generator handles the data distribution tasks for a substantially different set of receivers and

30 associated program guide data. For example, because different countries typically have substantially different program guide data requirements, a first feed

generator may be used to supply program guide data to one country and a second feed generator may be used to supply program guide data to another country. The queue generator divides the program guide data

5   appropriately between the first and second feed generators, so that each feed generator need only process the program guide data for its list of addresses.

The feed generators generally select the

10   program guide data with the highest priority for transmission to the receivers. Prior to transmission, the feed generators assemble compressed data records into messages. Each message contains multiple data records destined to the same receiver address. After

15   transmitting a message, each feed generator performs calculations to determine how long the receivers to which it has transmitted the message will take to process the data in that message. These calculations are based on knowledge of the data processing

20   capabilities of the receivers. For example, calculations may be made of how long it takes each receiver to process a certain type of program guide data record. Other factors that influence the feed generator calculations include the number and type of

25   data buffers in each receiver and the processing speeds of the receivers. The results of the feed generator's calculations may be used to update a log or to maintain a similar type of record that indicates which receivers are currently busy. The feed generator regulates the

30   flow of data to the receivers to avoid sending data to the busy receivers.

Because the feed generators handle the data flow regulation tasks associated with distributing data from the queue generator to the receivers, the local systems do not need to process the program guide data, which lessens the equipment requirements of the local systems.

Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawings and the following detailed description of the preferred embodiments.

Brief Description of the Drawings

FIG. 1 is a schematic diagram of a television program guide data distribution system in accordance with the present invention.

FIG. 2 is a schematic diagram showing various database and processor components of the program guide data distribution system in accordance with the present invention.

FIG. 3 is a schematic diagram showing program guide data structures that are used at various locations in the program guide data distribution system in accordance with the present invention.

FIG. 4 is a schematic diagram of two illustrative sets of addresses each of which is associated with a respective feed generator in accordance with the present invention.

FIG. 5 is a flow chart of steps involved in distributing data to receivers using feed generators in accordance with the present invention.

Detailed Description of the Preferred Embodiments

An illustrative program guide data distribution system 20 in accordance with the present invention is shown in FIG. 1. Main facility 22

5　contains a program guide database 24 for storing program guide data such as television program guide listings data, pay-per-view ordering information, television program promotional information, etc. Main facility 22 also contains at least one processor 26,

10　which is used to handle various data processing functions. Processed program guide data from main facility 22 may be transmitted directly to local system 28 via a satellite link or other suitable transmission path. Alternatively, main facility 22 may transmit

15　program guide data to an intermediate distribution facility such as uplink facility 30 via communications link 32. Communications link 32 may be a T1 telephone line or any other suitable communications link. Uplink facility 30 may contain processor 34 for processing

20　program guide data.

Uplink facility 30 transmits program guide data to local system 28 via communications link 36. If desired, more than one uplink facility 30 may be used in the data distribution system. For clarity, the

25　invention is described in connection with a single uplink facility 30. Uplink facility 30 typically distributes program guide data to numerous local systems over a national or international geographic area. Only a single local system 28 is shown in FIG. 1

30　to avoid over-complicating the drawings.

Link 36 may be a satellite link, a telephone network link, a cable or fiber optic link, a microwave

link, a combination of such links, or any other suitable
communications path. If it is desired to transmit
video signals (e.g., for promotional videos) over link
36 in addition to data signals, a relatively high

5   bandwidth link such as a satellite link may generally
be preferred to a relatively low bandwidth link such as
a telephone line. Information from local system 28 may
be provided to main facility 22 via a suitable
communications link if desired.

10   Local system 28 is a television distribution
facility such as a cable system headend, a broadcast
distribution facility, or a satellite television
distribution facility. Local system 28 is operated by
a television service provider such as a cable system

15 operator, a satellite television system operator, or a
broadcast television system operator.

          The program guide data transmitted by main
facility 22 to local system 28 includes television
program listings data such as program times, channels,

20 titles, descriptions, etc. Transmitted program guide
data also includes pay program data such as pricing
information for individual programs, subscription
channels, and packages, time windows for ordering
programs, channels and packages, telephone numbers for

25 placing orders that cannot be impulse ordered, etc. If
desired, some of this data may be provided using data
sources at facilities other than main facility 22. For
example, data related to pay program order processing
(e.g., billing data and the like) may be generated by

30 an order processing and billing system that is separate
from main facility 22 and separate from local system
28.

Local system 28 typically contains an integrated receiver/transcoder 38 and an out-of-band modulator 40. Local system 28 receives program guide data from uplink facility 30 with integrated

5 receiver/transcoder 38. Local system 28 distributes the program guide data to multiple users via communications paths 42 using out-of-band modulator 40. Each user has a receiver 44, which is typically a set-top-box, but which may be other suitable television

10 equipment into which circuitry similar to set-top-box circuitry has been integrated. Program guide data is distributed to receivers 44 periodically. Local system 28 may also poll receivers 44 periodically for certain information (e.g., pay program account information or

15 information regarding programs that have been purchased and viewed using locally-generated authorization techniques). Local system 28 generally does not need to use a processor to handle data distribution tasks, because data flow regulation tasks are handled by

20 upstream processors 26 and 34.

Receivers 44 preferably contain processors 46. Processors 46 process the program guide data received from local system 28 and manage a localized receiver-based program guide database. Processors 46

25 are also used to implement an interactive television program guide on each receiver 44. Each receiver 44 is typically connected to an optional videocassette recorder, which in turn is connected to a television. During use of the interactive television program guide,

30 television program listings may be displayed on the television. Each receiver 44 may be controlled by a

remote control or other user input interface such as a wireless keyboard, mouse, trackball, etc.

Communications paths 42 preferably have sufficient bandwidth to allow local system 28 to
5   distribute scheduled television programming, pay programming, promotional videos, and other video information to receivers 44 in addition to program guide data. Multiple television and audio channels (analog, digital, or both analog and digital) may be
10 provided to receivers 44 via communications paths 42. If desired, program guide data may be distributed by one or more distribution facilities that are similar to but separate from local system 28 using communications paths that are separate from communications paths 42.
15   Certain functions such as pay program purchasing may require receivers 44 to transmit data to local system 28 over communications paths 42. If desired, such data may be transmitted over telephone lines or other separate communications paths. If
20 functions such as these are provided using facilities separate from local system 28, some of the communications involving receivers 44 may be made directly with the separate facilities.

The program guide data distribution functions
25 of main facility 22 are provided using program guide database 24, platform-specific processor 48, and queue generator 50, as shown in FIG. 2. Platform-specific processor 48 and queue generator 50 may be implemented using processor 26 (FIG. 1). The program guide data
30 distribution functions of uplink facility 30 are provided with multiple feed generators 52, which may be implemented using processor 34 (FIG. 1). The program

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guide data distribution functions of local systems 28
are essentially limited to redistributing the program
guide data received from uplink facility 30 to
receivers 44. Program guide data processing in
5   receivers 44 is performed using processors 46 (FIG. 1).
The program guide data distributed to receivers 44 is
used in the electronic television program guides
implemented on receivers 44.

    FIG. 3 shows illustrative data structures and
10   processing steps that may be used for distributing
program guide data from program guide database 24 to
receivers 44. Main facility 22 maintains a
comprehensive set 54 of program guide data in program
guide database 24 (FIG. 1). Periodically (e.g., once
15   per day), platform-specific processor 48 extracts
program guide data from comprehensive set 54 to form a
subset 56 of program guide data. Subset 56 includes
program guide data for all receivers to which data is
to be distributed. Subset 56 preferably contains
20   sufficient data to cover the time range required by
receivers 44 (e.g., a weeks worth of data to cover
listings for television programs coming up in the next
week). In addition, subset 56 preferably contains
sufficient data to provide a supplemental buffer of
25   several days in length (e.g., four days). The
supplemental buffer allows program guide data to be
distributed without interruption over long weekends,
holidays, and short episodes of down-time at main
facility 22 (during which no new extracts of data are
30   made).

    Platform-specific processor 48 assigns
different groups of receivers 44 different addresses.

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A common address may be assigned to receivers 44
associated with a particular local system 28, receivers
44 in a single geographical region, receivers 44 in
multiple geographic areas, receivers 44 associated with
5   a single service provider, receivers 44 associated with
a single program guide product, or any other suitable
set of receivers 44.

Platform-specific processor 48 may also add
platform-specific data (i.e., data that is destined to
10 a particular platform such as all set-top boxes of a
certain type) to subset 56. Such platform-specific
data may include, for example, pricing and ordering
information for pay programming, information about each
local system 28 such as telephone numbers, logos,
15 display format information, information on the number
of channels supported, subscriber messages, program
guide configuration information, and other
supplementary information used by the program guides on
receivers 44. Each item of platform-specific data may
20 be provided with an address.

Queue generator 50 extracts portions of
program guide data from platform-specific processor 48
(preferably at the same regular intervals used by
platform-specific processor 48 when extracting data
25 from comprehensive set 54 to form subset 56). Queue
generator 50 inserts the extracted portions of program
guide data into master queues 60 based on queue
configuration data. Any suitable number of master
queues 60 may be formed in queue generator 50. Master
30 queues 60 are preferably made up of a number of ordered
lists 62, each of which contains entries associated
with respective program guide data records 64. Data

records 64 contain the program guide data provided to queue generator 50 from platform-specific processor 48.

     The queue configuration data used to configure master queues 60 may include information

5   specifying what type of data records should be placed in each queue. The queue configuration data may also include information specifying the duration covered by the list (i.e., the time range each list 62 should cover -- from 12:30 AM to 1:00 AM, etc.). Queue

10 configuration data may be used to specify how often data for master queues 60 should be transmitted to local systems 28 for distribution to receivers 44 (i.e., the transmission frequency for each master queue 60, which depends on how critical the data in each

15 master queue 60 is to a given local system 28). Queue configuration data may also be used to specify how often the data for the master queue 60 should be updated. Other queue attributes that may be configured include the start time of each list 62 and the

20 expiration time of each list 62 (i.e., the time at which the data in the list is supplanted by data in another list). The data in each list 62 typically expires at the start time of the next list 62 in master queue 60. Queue configuration data may be used to

25 define how often data for the queue should be transmitted after all data has expired (i.e., when the supplemental buffer is empty). When the supplemental buffer is empty, the data for some queues should no longer be transmitted and the data for other queues

30 should be transmitted more frequently. These configurable queue attributes are illustrative only.

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Queue configuration data may be used to specify other
suitable queue attributes if desired.

Queue configuration data may be supplied to
queue generator 50 by the operator of main facility 22
5   whenever it is desired to reconfigure the system. An
operator may supply the queue generator with queue
configuration data using any suitable technique, such
as entering the data with a mouse, trackball, or
keyboard, or supplying the data on a diskette, etc. By
10 supplying new queue configuration data, the operator
can readily adjust the number and type of queues that
are being used to process the extracted portions of
program guide data. This allows the operator to
optimize the data handling capabilities of the system
15 to accommodate the addition of new cable systems, even
though the bandwidth of the data distribution system
remains fixed.

Illustrative master queues 60 include a
service information queue (e.g., the left queue 60 in
20 FIG. 3), a current listings queue (e.g., the center
queue 60 in FIG. 3), and a seven-day listings queue
(e.g., the right queue 60 in FIG. 3). The service
information queue may be used for service information
such as call letters. Data records 64 may be of the
25 service record type. Because such service records are
not particularly time-sensitive, the service
information queue may cover the entire duration of the
extracted portion of the program guide (e.g., eleven
days -- a seven-day extracted portion of data plus a
30 four-day supplemental buffer). The service data may be
transmitted frequently (e.g., every five minutes),
because such data is relatively important for the

proper operation of the interactive television program guides on receivers 44. The data in the service information queue need not be updated, because it will not change during the period of time over which queue
5   generator 50 extracts the portion of program guide data from platform-specific processor 48. The data should be transmitted from a time beginning at the time at which the portion of data extracted from the platform-specific processor becomes valid and continuing until
10   the time at which the extracted portion expires.

The current listings queue may be used for schedule information, program listings, and program descriptions. For example, the current listings queue may include data for all programs that air between the
15   start time of the list and one half-hour later. Program guide data for the current listings queue may be transmitted every five minutes and may be updated every 15 minutes. Each set of data may therefore be transmitted three times. Each data set expires 15
20   minutes after it begins. Expired data sets are not transmitted.

The seven-day listings queue may also be used for schedule information, program listings, and program descriptions. The seven-day listings queue may include
25   data for all programs airing in the next week. The data for the seven-day queue may be transmitted every four hours and may be updated every eight hours. A set of data for the seven-day listings queue expires after eight hours. Expired data may be sent once every hour.
30   Queue generator 50 determines when the program guide data for data records 62 changes (either in program guide database 24 or in platform-specific

processor 48) and appends corresponding version numbers
to each data record 64. Receivers 44 only store new
data records 64 or data records 64 that have more
current version numbers than previously stored data

5   records 64. If desired, queue generator 50 can change
the version number on all data records 64 to force
receivers 44 to acquire all data records 64.

Program guide data from queue generator 50 is
preferably distributed to receivers 44 using a number

10   of feed generators 52, each of which is associated with
a particular set of addresses. As shown in FIG. 4,
feed generator No. 1 is associated with list of
addresses 66 and feed generator No. 2 is associated
with list of addresses 68. Although each feed

15   generator 52 generally handles the data for a different
set of addresses, the addresses in lists 66 and 68 need
not be mutually exclusive. More than one feed
generator 52 may process program guide data for the
same address if desired. Any suitable number of feed

20   generators 52 may be used. For example, three feed
generators might be used -- one to service Canada, one
to service the eastern United States, and one to
service the western United States. For clarity, the
description of the present invention emphasizes the use

25   of two feed generators (Nos. 1 and 2).

As shown in FIG. 3, after master queues 60
have been built and the version numbers associated with
data records 64 have been updated, queue generator 50
(FIG. 2) provides the program guide data 70 that is

30   associated with list of addresses 66 to feed generator
No. 1 and provides the program guide data 70 that is
associated with list of addresses 68 to feed generator

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No. 2. This arrangement improves system performance,
because it avoids duplication of effort by feed
generators 52. Program guide data that is to be
distributed only to the addresses associated with feed
5 generator No. 1 does not need to be passed through feed
generator No. 2. Similarly, program guide data that is
to be distributed only to the addresses associated with
feed generator No. 2 does not need to be passed through
feed generator No. 1. Each feed generator 52 therefore
10 needs to bring its full processing power to bear on as
little program guide data as possible.

If desired, a queue generator may be used
that creates multiple sets of master queues, each
associated with one or more respective feed generators.
15 Alternatively, a queue generator may be used that uses
one set of master queues and that passes this same set
of master queues to multiple feed generators in its
entirety along with a list of addresses for each feed
generator. Each feed generator then transmits only the
20 portion of the master queue data that is associated
with the addresses in its list.

Queue generator 50 compresses the program
guide data in data records 64 into compressed data
records 72 for use with the feed generators.
25 Compression reduces the bandwidth required by feed
generators 52 and lessens the memory requirements of
receivers 44. Queue generator 50 also processes the
information in master queue lists 62 to form feed-
generator-specific lists 74 in feed generator queues
30 76. Each feed generator list 74 contains references to
associated compressed data records 72.

Feed generators 52 construct data messages 78 for receivers 44 from the feed generator queues 76 and the associated compressed data records 72. The active lists 74 (i.e., the lists 74 that are being transmitted by each feed generator 52) are prioritized by factors such as expiration time, the number of messages remaining to be transmitted, the next scheduled message transmission time, the state of the list (e.g., whether all of the data for the list has expired), and an arbitrary priority assigned to each feed generator queue 76. The priority of the various lists 74 shifts over time, as certain queues become filled up and other queues empty. Each feed generator 52 constructs messages starting with data in the highest priority queue and continuing with data in the same or other queues that share the same address. Messages 78 are transmitted to local systems 28, where they are shown as messages 80 in FIG. 3.

Steps involved in constructing messages 78 and distributing messages 78 to local systems 28 with each feed generator 52 are shown in FIG. 5. At step 82, feed generator 52 locates the highest priority feed generator queue 76. At step 84, feed generator 52 locates the next data record 72 to be transmitted for that queue 76 while avoiding data records 72 with addresses corresponding to busy receivers. Information on which receivers are busy may be maintained in a busy receiver log or a similar type of data structure. At step 86, feed generator 52 locates a sufficient number of other data records addressed to the same destination to construct a complete message 78. The data records located by feed generator 52 are initially taken from

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the highest priority queue and are then taken from other queues in order of descending priority. At step 88, feed generator 52 transmits the complete message to its designated address. At step 90, feed generator 52

5 calculates the length of time the receivers 44 to which the complete message was transmitted will require to process the message and updates the busy receiver log accordingly. Feed generator 52 then returns to step 82.

10 The calculation at step 90 of the length of time receivers 44 will take to process the message requires that feed generator 52 be provided with information on the processing speed of the particular types of receiver 44 that are involved. Feed

15 generators 52 are also provided with information regarding the number of buffers in receivers 44 and their characteristics. In addition, the calculation requires that feed generator 52 be provided with information on the processing times associated with

20 various tasks. For example, it may take 150ms to process a program schedule record (e.g., a record containing a program listing for channel 4 at 9:00, etc.). It may take 110ms to process a program text description. It might take 80ms to process a logo,

25 etc. Based on this type of information, feed generator 52 determines the total amount of time certain receivers 44 will be busy following transmission of a message 78. The results of the calculation are used to update the busy receiver log, so that the next message

30 that is transmitted will not be sent to a busy receiver. Each feed generator 52 is preferably provided with sufficient information (e.g., from the

operator of main facility 22) to make the processing
time calculations of step 90 for the receivers 44
associated with the local systems 28 serviced by that
feed generator 52.

5   The messages 78 that are transmitted by feed
generator 52 are received by local systems 28 and
retransmitted to receivers 44. Local systems 28 do not
need to process the messages, which minimizes the
expense of the equipment required in local systems 28.

10   Each message has an associated address. When
a receiver 44 receives a message, the received address
is compared to a set of predefined local addresses for
that receiver. Messages whose addresses do not match
any of the predefined local addresses are discarded by

15   the receiver, so that the receiver does not waste time
processing a message not intended for that receiver.

Messages with matching addresses are divided
by the receiver into individual data records, each of
which is processed separately. Each data record is

20   processed to determine whether a corresponding data
record is already stored in the receiver's memory. If
a data record is located in memory and its version
number is the same as the data record that was just
received, the data record that was just received is

25   discarded. If the data record that was just received
has a different (i.e., newer) version number, the data
record in memory is discarded and the data record that
was just received is stored. If there is no match
between a newly received data record and a data record

30   already in memory, the newly received data record is
stored. Because receivers 44 filter out all but
properly addressed messages that contain new data,

receivers 44 do not expend unnecessary time processing data records.

The foregoing is merely illustrative of the principles of this invention and various modifications
5 can be made by those skilled in the art without departing from the scope and spirit of the invention.